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A REPORT BY
THE SECTOR TASK FORCE ON

THE CANADIAN ELECTRONICS INDUSTRY

Chairman L. D. Clarke

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-78E43

REPORT
OF THE
TASK FORCE
ON THE
CANADIAN ELECTRONICS INDUSTRY

AUGUST 1978

The Honourable Jack H. Horner
Minister, Industry, Trade and Commerce
235 Queen Street
OTTAWA, Ontario
K1A OH5

Dear Mr. Horner:

In response to your letter of March 19, 1978 I have the honour and pleasure as Chairman of the Electronics Sector Task Force to submit the enclosed report on behalf of the members. We believe that you will find the discussion and recommendations contained in this report to be constructive and useful in the development of policy measures to improve the performance of this important sector of Canadian manufacturing and of the national economy.

Our work began with a review of the Sector Profile discussion paper prepared by your department which we found to be a realistic reflection of our industry. It has been brought up-to-date in the light of comments made by the Task Force, and is appended to this report.

The membership of the Task Force included representatives from industry, labour, the academic institutions and some of the provinces. A list of observers from other provincial governments, federal government departments and from two industry associations also attended at various times and I wish to express my appreciation for their contributions to the debate. A list of members and observers is attached.

Three meetings were held with almost full attendance on each occasion. Our discussions were full and frank and a consensus was achieved among the membership on the issues addressed. Accordingly, there are no dissenting opinions or minority views contained in the report.

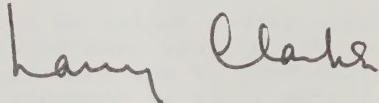
The contributions by Mr. A.R. Hollbach and his staff, as the Task Force Secretariat, were of much value to us. Their discussion papers aided our deliberations on several issues and their logistical support ensured that everything came together in a timely manner.

Although the presentation of this report completes our assignment, I understand that further attention is to be devoted to industrial policy issues by First Ministers later this year. On behalf of the Task Force, I wish to express our appreciation for the opportunity to comment on a number of issues that have concerned us for some time. I also wish to express our sincere desire to participate in the ongoing process in whatever capacity may be appropriate. In this regard I would place myself at your disposal.

I am sending a similar letter with a copy of the report to your provincial colleagues.

Respectfully submitted,

Yours truly,

A handwritten signature in cursive script, appearing to read "L. D. Clarke".

attach.

L. D. Clarke

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Electrical and Electronic Manufacturers Association

Canadian Manufacturers' Association

Provincial Governments

Government of British Columbia

Government of Manitoba

Government of Saskatchewan

Federal Government Departments

Department of Communications

Department of Employment and Immigration

Department of Finance

Department of Industry, Trade and Commerce

Labour Canada

Department of Regional and Economic Expansion

Department of Supply and Services



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Receiving This Task Force Report

The Honourable Robert Banman
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The Honourable A.M. Cameron
Minister of Development
Province of Nova Scotia

The Honourable R.W. Dowling
Minister of Business Development and Tourism
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The Honourable Tom Farrell
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Province of New Brunswick

The Honourable Don Phillips
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Province of British Columbia

The Honourable John Rhodes
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Province of Ontario

L'honorable Rodrigue Tremblay
Ministre de l'Industrie et du Commerce
Province de Québec

The Honourable Norman Vickar
Minister of Industry and Commerce
Province of Saskatchewan

ELECTRONICS TASK FORCE REPORT

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EXECUTIVE SUMMARY

The electronics industry is the principal core industry whose capabilities are fundamental to Canada's future industrial prosperity and economic growth.

The electronics industry can fulfill this key role if:

- a) it can be assured of preferred access to Canadian markets, particularly those arising from Federal and Provincial Governments, Crown corporations and regulated public utilities; and
- b) it can be assured of an improved climate for investment, particularly with respect to research and development expenditures; and
- c) a concerted effort is made to procure future major electronics systems from Canadian prime contractors with particular emphasis being given to the encouragement of Canadian-owned companies in this special field of expertise.

ELECTRONICS TASK FORCE REPORT

PART I

Background and Objective

This report is submitted in response to a letter dated March 29, 1978 from the Minister of Industry, Trade and Commerce which set out a general mandate for this and other industry sector Task Forces and invited them to contribute to the development of government policies which would revitalize the economic performance of the country.

During the first meeting of the Task Force several key factors surfaced which have formed the nucleus for the philosophy underlying this report. These factors are:

- 1) Canada's economic health in the coming decades will depend increasingly on our capacity for technological innovation in order to produce goods and services that are internationally competitive.
- 2) Recent studies have shown that high technology industries grow at a rate three times that of other industries and employment growth in high technology industries approaches nine times that of other industries.
- 3) Canada is unique in the industrialized world in its reluctance to employ non-tariff barriers to protect its high technology industries. In this regard it should be noted that those nations which are the best practitioners of the NTB game vis-à-vis high technology industries have the most vibrant and fastest growing industrial economies.
- 4) Exploitation of the opportunity provided by technological leverage in the electronics sector, where the technology is evolving rapidly, will create new industry and new employment on a scale seldom witnessed in Canadian history.
- 5) The efficient and competitive exploitation of Canada's natural resources and thus their future marketability will depend increasingly on the development of new electronically based technology in the fields of exploration, production and processing.

Electronics worldwide is the largest and most diversified of the high technology industries. It is the one industry that is a fundamental necessity to every advanced industrial economy. The electronics industry is an environmentally clean high-growth industry. The electronics industry has relatively modest capital requirements and is a large employer of skilled people. In summary the electronics

industry is a vital element relating to Canada's ambition to remain an industrialized nation.

The objective of this report is to set out clearly the important issues concerning the electronics industry within Canada. We earnestly request that our recommendations evoke a positive response. The recommendations are bold, but if this country is to survive as an industrial nation in the coming decade, bold initiatives are required. We believe that with a positive and unequivocal response from government and industry the electronics sector will build on its demonstrated strengths and will fulfill its potential contribution to Canada's long-term national economic recovery.

Because of the limited time available, the Task Force regrets that it was unable to prepare all the substantiating data that would have been available over a longer period. Nevertheless the extensive experience held by all the members, arising from a long and deep involvement in the Canadian electronics industry, has given rise to an extremely high level of confidence in the appropriateness of the subsequent recommendations.

PART II

The Strategic Position of the Industry

1. Electronics - An International Industry

As illustrated in the sector profile discussion paper which accompanies this report, a high degree of international trade is a key characteristic of the electronics industry. Over the past decade all the major participants in the industry, with the exception of Japan, have seen imports take increasing shares of their domestic markets. At the same time, most of these countries have substantially increased exports and have thereby maintained a favourable trade balance despite increased imports.

Canada has not fared well in this international market-place, for although our exports have increased markedly, imports have increased more sharply and now account for about half the domestic market. Appendix I attached provides a graphic illustration of the Canadian position relative to others and highlights the special situation of the Canadian electronics industry.

2. The Canadian Electronics Industry in the International Environment

In assessing the position of the Canadian industry in the international market two issues must be considered:

- . the need for the industry to remain technologically competitive in the international marketplace, and
- . the need for governments to ensure that the business environment in Canada is at least as attractive as in other countries.

With respect to the first issue, individual Canadian electronics firms have demonstrated technological competence the equal of any other country and in many areas have been technological leaders. It is also important to note the substantial international marketing successes achieved by elements within the sector. In some segments of the industry more than 80 per cent of value added is derived from export sales. These segments are technologically equal to the world leaders, and are commercially viable.

With respect to the second issue, other national governments have recognized the inherent attractiveness of maintaining a viable electronics sector and have ensured that substantial measures of support are available to it. For an industry which is highly international in character, the attractiveness of competing business environments is a critical factor. The industry will continue to expand and contribute to Canadian economic growth only insofar as the Canadian climate remains attractive relative to other jurisdictions. It would be tragic if the demonstrated potential of the Canadian electronics sector were to be lost because of more aggressive government action elsewhere.

3. Electronics and Comparative Advantage

As we face the prospects of a more competitive post-MTN international trading environment, we must identify potential strengths in order that we can build on them for the future. The electronics industry offers considerable scope to this end.

One of the realities of the international economic environment is the existence of high and low cost labour markets and the competitive pressures that have developed as labour-intensive manufacturing processes relocate to take advantage of comparatively lower-cost labour. The emergence of developing countries as important assemblers of electronic components, particularly for consumer products, has underlined the economic advantages possessed by these lower-cost labour markets. As these less developed countries seek to continue to exploit their economic advantage, it appears inevitable that more and more of the labour-intensive production processes will shift in their direction.

One immediate consequence of this phenomenon is a concern for the loss of manufacturing jobs in the domestic economy. Rather than delaying the inevitable consequences of structural weaknesses with expensive short-term measures, such as import quotas, a more positive approach would be to identify areas where Canadian industry possesses comparative advantages and to seek to exploit those strengths.

The strength of Canada's economy over the last three decades has been largely built on the resource industries. The Task Force believes that Canada can no longer rely on its resource-based industries as the principal base for stable growth in the future. The knowledge-intensive high technology industries, such as electronics, complement and support the resource industries through the supply of internationally marketable skills such as the design, development and implementation of new techniques, devices and systems.

A number of Canadian electronics firms have demonstrated their ability to operate successfully at the leading edge of the technology spectrum. By greatly strengthening and broadening this capability, Canada's electronic industry will be able to continue to compete effectively in our domestic and world markets and thus contribute fully to the country's economic growth. Therefore, with this proven ability the electronics sector offers a prime opportunity to develop and exploit a comparative advantage within our manufacturing sector.

4. Electronics and Industrial Application

The electronics industry is one of the more important growth sectors in our economic system; it is equally important in providing the technology for productivity improvement in other sectors of industry. Thus developments in, for example, the semi-conductor field and integrated circuits have brought about a significant reduction in

the size and cost of electronic devices. This has made feasible the application of these new devices to a wide variety of industrial processes and control systems, thereby strengthening the competitiveness of Canadian industry generally. For Canada, this is particularly significant in the fields of transportation, communication and resource processing.

5. Summary of Industry Characteristics

The electronics industry offers an opportunity to exploit a non-resource based Canadian comparative advantage in the international marketplace. As an important growth sector it provides potential for high quality employment compatible with Canadian requirements and skills.

Apart from being an important growth sector in its own right, a healthy electronics industry will provide the base for technological change throughout Canadian industry. Electronics is the key to ensuring competitive manufacturing and processing sectors.

Canadian electronics companies have demonstrated technological competence and economic viability in the international marketplace, but, increasingly, other governments are moving to attract electronics industrial development to their own jurisdictions. Canada must provide a business environment at least as attractive as the competition as well as enhancing areas in which the industry has demonstrated its technological leadership.

6. Other Background Considerations and Assumptions

Against the background outlined above, and before detailing the issues to be considered, we wish to note a number of assumptions which are implicit in our analysis of the problems of, and prospects for, the industry.

(a) Economic Growth Rate

We do not see the high GNP growth rate target of the Minister of Finance as being realistic, and we believe that actual performance will fall significantly short of that target.

(b) Multilateral Trade Negotiations

We assume that Canada will be party to an agreement which will:

- (i) provide for a reduction in tariffs, and
- (ii) institute a code for dealing with non-tariff barriers.

We further assume that the tariff-cutting formula will be less than the earlier considered "Swiss" formula (i.e. 40%) and that the code, however desirable and useful, will have little effect in removing non-tariff barriers (NTBs) in those foreign markets currently closed to Canadian electronics firms.

(c) Government Support for the Electronics Industry

We assume that the governments of other countries will maintain a strong commitment to the maintenance and expansion of their electronics industries and that they will continue to pursue policies designed to create a protective environment for electronic industry members within their own national jurisdictions.

PART III

Issues and Recommendations

Productivity in the electronics sector is an important element of its ability to compete in international markets, and actions taken to improve productivity will clearly benefit the industry in the future.

Recognizing this, the Task Force is recommending to the members of its industry association and its member unions that they undertake a study of manufacturing efficiency in a manner similar to that currently under way in the aerospace industry. Particular consideration should be given to enhancement of human resources, factor-productivity, improved management systems and better approaches to the exploitation of market opportunities.

This will be a private sector initiative. Further concerns which would require government initiatives are:

Firstly, the industry must have available to it the technical and financial resources necessary to maintain a competitive position in the development and application of new technology.

Secondly, governments must recognize the strategic importance of a viable electronics industry, both in its own right, and as the key to improving the productivity of other manufacturing and resource processing operations, and make a high priority commitment to improving the industry's business climate.

Thirdly, a massive and continuing commitment by governments to a technologically-based industrial system is essential. Given the existing fiscal constraints, such a commitment may require a major reordering of priorities in favour of productive versus social investment. The medium to longer-term advantages will be derived from higher levels of wealth creation and the commensurate capacity to attain social objectives. This would lead to a reduction in the cost to the Canadian economy of maintaining social support programs and thus the need for them. While the short-term costs of a massive commitment to the electronics sector will be significant, the Task Force is convinced that the longer-term economic benefits will more than justify the initial investment.

Specific Issues

Technology

One of the most important characteristics of the electronics industry is the fundamental importance to firms of technological strength and effort. Indeed, the survival of an electronics firm depends almost wholly upon its ability to remain at the leading edge of technological change. If this position of technological leadership is lost, the momentum of change makes it almost impossible to regain

lost ground and the products and production processes very quickly become obsolete. These pressures require firms continually to devote the same kind of intensive attention and effort to research and development that other industries devote to occasional large capital investment decisions. This fact is particularly pertinent to Canadian-owned firms which are unable to draw upon the technological skills of foreign-owned parents.

R&D activity by electronics firms is the critical factor in determining the rate of productivity growth in the industry. Productivity growth within the electronics sector has been extremely rapid because it has resulted from striking advances in technology, rather than from the ongoing process of adjustment and improvement common to other sectors with more established technologies.

Within the area of technology, the crucial activity is the application, adaptation and extension of basic research to produce goods and services for which there is a commercial market. The basic research underlying new electronic goods and services and production processes is relatively cheap and easily accessible. Few, if any, of the successful firms undertake basic research. The vast majority of a firm's effort allocated to R&D is devoted to the entrepreneurial activity of developing products for which there are commercial applications. This process is time consuming, difficult, and costly. Typically it takes seven years to bring a new product to market. Under these conditions, government support for technological activity heretofore focused heavily on basic research, has missed the opportunity to stimulate adequately that part of the R&D process that gives rise to the principal economic benefits within the electronics sector.

In high technology industries such as electronics, expenditures on research and development represent an investment as critical to the production process and competitiveness of the firm, as investment in plant and equipment is in other sectors. A decision by an electronics firm to pursue a particular R&D program requires the commitment of a significant part of its resources over an extended period of time. The investment incentives of government which traditionally have focused on tangible capital investment, or on the development of resources, have had little impact on creating a favourable investment climate within the electronics industry.

The government's influence over decisions on R & D programs has often been negative because of the poor design of its programs and measures for technological assistance. Three features have limited the benefit the industry has received and thus the government's ability to influence the development of the electronics industry. These are the "stop-go" nature of supportive measures, the incremental approach taken by certain supportive measures toward a field of dramatic technological change, and the entrenched emphasis on basic rather than applied research.

The recent policy initiatives of the federal government to support technological activity are a welcome sign that the government is becoming concerned about Canada's performance in the area of R&D. The electronics industry, as one of Canada's most technology-intensive

industries, stands to benefit from these measures, but they are far from adequate to permit the industry to support the level of R&D required if it is to grow to its potential. The government must recognize that massive investment in R&D by industry will be required over a sustained period of time for it to achieve its objectives for growth. Clearly, the magnitude of support required to create a favourable environment for this investment will influence government expenditure priorities. If the explosive growth of which the electronics industry is capable is to be achieved, greatly expanded government support to R&D is imperative.

There are a variety of mechanisms which could be used by government to provide a major infusion of continuing support for technological work by the electronics industry. One set of measures which the Task Force would commend to the government for consideration is the following:

- 1) R&D incentives to be part of a national industrial development program to be formulated by the Federal Cabinet. Primary ministerial responsibility to be assigned to the Minister, Department of Industry, Trade and Commerce (ITC). Other Ministers to ensure that their departments act in a co-ordinated way in support of the national program.
- 2) The Cabinet to approve specific objectives for the R&D incentives, against which progress can be evaluated. The long-term nature of R&D and innovative processes to be considered in setting these goals and in formulating and committing policies and programs.
- 3) The Minister, ITC, establish guidelines for the application of R&D incentives, concentrating on industries with present or potential international competitive strength, usually reflecting a strong market base, in the interest of selecting those R&D opportunities where success is most likely and brings the greatest economic benefits.
- 4) R&D incentives to be developed and applied within the national industrial development program. Specific recommendations for government action include:
 - Establish an R&D tax rebate equal to 25 per cent of all R&D expenditures, both present and incremental, in lieu of the present five per cent tax credit. This tax rebate to be capable of being carried forward for five years.
 - Reduce income taxes on profits from new businesses or products resulting from R&D innovation.
 - Strengthen existing mechanism of R&D support to enable substantial funding of R&D activities in selected industry segments, particularly for those with export potential and for small businesses.

- Support university research activities, selectively and consistently, and encourage universities to do more applied research in collaboration with industry.
- 5) The Minister, ITC, to establish vehicles to maintain the momentum of the R&D incentives and to monitor and report their progress and effectiveness to the Cabinet.
- 6) The R&D incentives to be complemented by other programs included in the national industrial development program which will increase likelihood of success, such as:
 - Buy Canadian preference in the selected industries.
 - Continue to emphasize Contracting Out policy for R&D.
 - Trade agreements to open selected export markets, or to locate R&D activities in Canada (the latter in the case of non-Canadian companies), in return for foreign entry into selected Canadian markets.
- 7) The Cabinet and the Ministers to support the R&D incentives program by encouraging:
 - Provincial government co-operation.
 - Political and business climates that are perceived as encouraging and rewarding successful R&D and innovation.
 - Economic, social and academic incentives which develop, attract to and retain in Canada, high technology and other knowledge workers and enterprises.

The impact of these measures on the performance of R&D and on the growth and size of the electronics industry will occur only over the medium to longer term, reflecting the fact that R&D expenditures are in the nature of an investment. Indeed, over the short run it may appear that the support provided by government is going to activities which would have taken place anyway. This is inevitable while firms are building up their technological strengths. However, over the medium term, government could expect to see very strong growth in the competitiveness and size of the electronics industry. The Task Force is confident that industry growth arising from significantly increased R&D will permit substantial medium and long-term reductions of trade barriers for electronic goods and services on a reciprocal basis with our trading partners. The Task Force considers that the ultimate benefit to Canadian consumers based on current sales and tariff levels could be not less than \$300 million annually in the medium term, and very substantially greater in the longer term.

Financing

The central financial issue confronting the electronics industry is the availability of risk capital. While this is a common

problem for many sectors, and especially for small businesses, there are several features of the electronics sector which increase the risk element of investment in the electronics sector. Among these are:

1. Rapid technological obsolescence.
2. Rapid product obsolescence and changing markets.
3. A small domestic market for electronics products and services.
4. A long investment period prior to the anticipated payback.
5. Financial vulnerability of small Canadian firms versus international giants operating in an open market.

The risk capital financing needs of the electronics sector are not easily met through the existing financial system in Canada. The major financial institutions such as banks, trust companies, insurance companies and pension funds are constrained from entertaining substantial risk ventures by legislation and by the need to pursue conservative investment policies on behalf of their depositors and policy holders. Venture capital companies may be reluctant to commit funds to high technology investments because they do not always understand the technology they are dealing with. Frequently a proposed new venture is not sufficiently large to interest an institutional venture capitalist.

The recent proposals from the federal government to introduce a Venture Enterprise Investment Corporation may meet some of the needs of the industry for flexible, high risk capital but the VEIC and other financing media are unlikely to supply the large volume of risk capital the industry needs.

A more promising source of capital for the industry appears to be the savings of private individuals who would be willing to make a risk investment in a particular firm in anticipation of making substantial capital gain. However, a number of government initiatives have combined to make high technology investment relatively unattractive.

First, the taxation of capital gains, by substantially lowering the effective return the investor realizes (assuming the venture is successful) reduces the desire to undertake the risk. The capital gains tax reduces the potential reward without reducing the risk. Second, personal tax incentives to invest in RRSPs and RHOSPs provide the individual investor with alternative investment vehicles which offer high real rates of return with very little, if any, risk.

The Task Force recommends the government provide fiscal incentives for the electronics sector as it has for other sectors such as films or oil and gas, that will result in enhancing the risk-reward ratio sufficiently to attract the needed volume of risk capital.

There are a variety of tools government could use to achieve this, but the tax system would appear to be the most efficient and effective. To this end, the Task Force would recommend the following initiatives:

- (a) Exemption from the capital gains tax for the electronics sector along with realistic phasing-out procedures for carry forward of losses for taxpayers with capital losses. This exemption to be related to treasury stock only and be conditional on the investment being held by the original investor for a period of time appropriate to achieving the purpose of the original investment.
- (b) Permit loss flow-throughs to investors in newly incorporated private companies such that the losses earned by a new company in its starting years could be prorated through to the investors to be used in computing their personal tax situation. A similar provision is available in the United States and is known as the "Chapter S" measure.
- (c) The creation of a capital instrument to provide tax-free income for a period of years with no erosion of the original capital invested. It could include the following features:
 - (i) An unsecured loan with the maximum interest rate being the bank prime rate.
 - (ii) After a ten-year period, redeemable at face value or convertible into share equity of the corporation at a nominal amount of extra investment.
 - (iii) Subordinated to all other indebtedness of the corporation.
 - (iv) Repayments and interest to be considered as a recovery of capital for the investor to a maximum of the initial investment and as a deduction from income for the corporation.
 - (v) Provision for any losses to be written off against other income.

With respect to the exemption from capital gains tax, the impact may appear to be minimal, as current total government revenues from this source amount to a small fraction of total government tax revenues. However, the psychological impact of the exemption from tax would be considerably greater than the actual sum involved. The exemption would constitute dramatic evidence of the government's desire to foster economic growth in the electronics industry and would thus improve the overall entrepreneurial investment climate.

The second proposal would influence more conservative investors to invest in the electronics industries, thus augmenting the limited resources of the entrepreneur. Although time did not permit

the development of estimates of the impact in terms of investment in the electronics industry, some idea of the effects it might have could be gained from the experience of the motion picture industry which found that significant pools of capital became available in response to special tax treatment.

Markets

While many secondary industry sectors face serious difficulty in maintaining or improving their current position in the Canadian and world economy, the electronics industry is one sector with the potential for very rapid growth. Thus, if realistic GNP growth targets are to be achieved, it will be important to ensure that this high growth sector has access to markets for its output.

Of prime importance to the future of the electronics industry is access to a stable, growing domestic market. Only from such a secure base can the industry hope to compete aggressively in export markets over an extended period of time. The importance of securing the domestic market for local producers has long been recognized by every major electronics producing country. NTB's and tariffs have closed European and Japanese markets for electronics equipment to exporters, and the U.S. defence and space programs and the Buy America Act have provided a huge protected market for that country's electronics firms. The Canadian electronics industry is confident that in the longer term it could survive in a world freed from barriers to trade (as noted above, the industry is willing to see the gradual elimination of all trade barriers). However, while the industry is building its strength and its major competitors are all working from within protected home markets, it is crucial that the Canadian industry have similar protection. Currently, this does not exist.

The Canadian electronics industry is proud of the fact that despite these unfavourable conditions of trade it is a significant exporter of goods and services, with some firms selling a majority of their output in export markets. While our industry will strive to continue this dynamic performance it must be recognized that it is a highly risky situation under the present conditions governing both international trade and the domestic market.

As demonstrated by the consumer electronics subsector, we have learned that the policies of foreign governments can cause damage to our domestic industry, by taking the markets which are crucial to the survival of our industry. Because of the open nature of the Canadian market, it can be lost to domestic suppliers as a result of predatory pricing policies of competitors operating from closed market bases. Additionally, it should be noted that foreign countries, as well as reserving home markets for domestic producers, provide generous support for export efforts, particularly in the form of concessional financing. A similar, although more expensive, financial service is available to Canadian exporters from the Export Development Corporation, but no such support is available to counter the impact of foreign sales incentives in the domestic market.

Another problem Canadian electronics firms must deal with is the fragmentation of the domestic market among an excessive number of suppliers. Corporate scale is important in the electronics industry because of the heavy burden of research and development costs which can only be paid for by substantial cash flows. Government policy, which encourages the continued existence of an uneconomic number of producers in the interests of ensuring competition, serves to reduce the ability of each firm over the long-term to compete against large foreign competitors.

A final feature of the industry that should be noted, is that a large proportion of its output is engineered products and that a substantial portion of the industry's production is sold to universities, governments and their agencies and to regulated utilities. This feature makes government procurement and regulatory decisions particularly powerful tools for influencing the development of the industry.

The Electronics Industry Task Force recommends that, having due regard to Canada's GATT obligations, the following measures be implemented to ensure that Canadian producers of electronics goods and services have the markets necessary to support their growth and development:

- 1) A procurement policy should be established to have "chosen instruments" selected in specified areas where unique capabilities have been, or can be, developed. These areas would likely lie in the forefront of technological development where worthwhile opportunities exist for foreign market penetration.

The Task Force recognizes that this proposal will require some modification to the competitive procurement regulations and practices of governments, and urges governments to make appropriate exceptions in order to exploit worthwhile opportunities.

- 2) A "Buy Canadian First" policy should be established in certain markets which would rely on a new concept of Canadian content related to the long-term industrial development impact it would have in Canada. A case in point would be the utilization of Canadian technological skills that would enhance corporate development momentum on a viable and sustainable basis.
- 3) A "Buy Canadian First" policy should be promoted through the various departments of both federal and provincial governments, and all departments should have as a stated aim the encouragement and development of domestic industry. This policy should also extend to Crown corporations and regulated utilities.

- 4) Policies should be adopted to encourage or, in the case of large contracts, require consultation among the various departments of the federal government to standardize and consolidate their requirements at an early point in time, with the stated aim of maximizing Canadian industrial involvement.
- 5) All levels of government and regulated utilities should adopt a policy that would permit the payment, if necessary, of a premium to Canadian suppliers for procurements of goods or services that are deemed to have a major impact on the long-term development of an industry or the economy as a whole. It should be recognized that this premium may be substantial in the early stages. It should be regarded as an investment and would diminish over time.
- 6) Where major foreign purchases cannot be avoided, it should be policy that offset arrangements be made part of the procurement package.
- 7) In assessing the merits of foreign versus domestic procurements, the net economic benefit to the country should be recognized and applied.
- 8) With respect to non-tariff barriers, reciprocal action must become part of Canadian commercial policy.
- 9) Procedures should be established to co-ordinate the procurement requirements of Crown corporations and regulated utilities at all levels of government.

The proposed measures would ensure that Canadian producers have the same stable home market base as their foreign competitors. This is important not only for adequate base loading but particularly for establishing credibility in export markets. Canadian manufacturers have experienced all too frequently the problem that if they cannot sell to their own government they cannot sell abroad. Thus with the assurance of a domestic base, the Task Force is confident that the Canadian electronics industry is sufficiently dynamic that it would be able to compete aggressively and effectively in world markets. If Canada fails to provide a domestic market base, the development of the electronics industry will be shaped, not by Canadian policy, but by the industrial policy of foreign countries.

As a result of these proposed marketing measures, over the medium to longer term, the Canadian electronics industry would be in a sufficiently strong competitive position to accept the multilateral removal of non-tariff barriers and the elimination of tariffs. Thus the impact of these measures will be to improve the strength, size and competitiveness of the industry to the point where it would be able to compete in a world market free of NTBs and other barriers.

PART IV

Systems Electronics - A High Priority Sub-Sector

The foregoing section of the report focused on horizontal issues which are of fundamental importance to this industry. In this section of the report, attention is given to an activity - systems electronics - which offers very promising prospects for the future growth and competitiveness of this industry and for which the horizontal issues are particularly important.

The term "systems electronics" refers to the integration of a variety of electronic devices and equipment into an arrangement designed to transmit, receive and manipulate data or to monitor and control activities and functions. Typical applications are sophisticated industrial process control, advanced weapons control systems, air traffic control systems and power generation and distribution systems. By definition, systems electronics requires a mix of sensing, instrumentation, communications and computing devices.

In the electronics field it is becoming increasingly evident that, in both government and industrial markets, customers are moving towards purchasing their requirements on a total system basis, particularly in the larger-scale projects. Examples are found in such markets as communications, data processing, industrial control and defence. It is just as evident that the future competitiveness of the Canadian electronics industry will depend to a large degree on its ability to undertake systems integration work and to have a domestic market for this type of work.

The electronics systems house, like the aircraft or automobile manufacturer, provides a focal point for the technological thrust and market base of the industry. In Canada, electronics systems would become the leading activity around which the components and sub-systems manufacturers would develop their expertise and domestic market base to participate more effectively in the expanding range of market applications at home and abroad.

The requirements of systems houses will provide opportunities for the components and sub-systems manufacturers to participate more competitively in the expanding range of market applications. The objective is the upgrading of the systems design, development and integration ability of the Canadian electronics industry. The applicability of systems skills to a wide range of industrial, commercial and military requirements is the compelling reason why this issue must be considered as an important element of industrial development policy for this sector. The demand for systems electronics skill provides an opportunity for growth within the Canadian electronics sector which can be realized provided there are detailed and concerted actions by government and industry to develop systems electronics competitive with those initiated by other industrialized countries.

Canada has few systems electronics companies per se but a number of firms have developed competitive sub-systems abilities and have the potential to undertake major systems electronics projects. The problems they currently experience can be summarized as:

- The high cost of bid proposals.
- The sporadic nature of projects and the long-time interval between project definition and implementation.
- The need for "bridging" activity to ensure that technical teams do not disperse but remain updated on technology trends.
- The financial burden of maintaining the human resource capability and the difficulties in obtaining financing of large contracts.
- The high risk factors often associated with unique and complex projects and the difficulties in estimating costs of software.
- The inadequate depth of corporate resources and scale to cope with these demands.
- The fragmentation of resources and duplication of capabilities arising from the existing industry structure.
- The lack of credibility in export markets arising from inexperience as prime contractors in the domestic market.

Accordingly, it is recommended that the measures discussed in the previous section of this report be applied in a concerted manner and on a selective basis to further develop the systems electronics capability in Canada. More specifically, it is recommended that:

- all levels of government, Crown corporations and regulated utilities make strong efforts to channel systems electronics projects through Canadian prime contractors;
- Canadian ownership of electronics systems firms must be encouraged in order to progressively develop an indigenous capability in systems work;
- governments and industry should develop appropriate planning programs to ensure that key personnel of systems groups remain active between major projects;
- the systems business may involve some manufacturing outside Canada and there should be adequate recognition by governments of this fact;

- governments should review their policies of insistence on fixed price software in systems contracts at least during initial phases of major projects.

Companies should be encouraged to seek logical mergers, acquisitions or consortia in order to consolidate resources and to broaden the scope of capabilities. Associations with foreign systems companies should also be sought where necessary, to assist in building up the Canadian base of expertise in technology and marketing.

The Task Force considers that these measures would establish a broader base of electronics manufacturing in Canada and enhance its international competitiveness. This could be spurred in a shorter term by Canada's current defence requirements such as the Canadian Patrol Frigate Program. Over the longer term, the systems integration capability could be applied to improving productivity in other sectors of primary and secondary manufacturing in Canada and to service sectors such as transportation and energy distribution. From a sector point of view, the electronics industry would be better equipped to exploit opportunities in export markets for larger-scale projects which, over the longer term, would contribute to redressing Canada's current imbalance of trade in electronics goods.

PART V

Other Horizontal Issues

In addition to the three major horizontal issues addressed in Part III, Task Force members identified a number of other areas of special concern to the electronics industry. These can be discussed under the following headings:

1. Foreign Ownership and Corporate Behaviour

The Task Force considered this issue and concluded that the important factor is not corporate ownership but corporate behaviour.

The Task Force recommends the publication of a set of guidelines for corporate behaviour as set out in Appendix "II" attached to this report.

2. Regional Economic Development

The electronics industry is heavily concentrated in the Toronto-Ottawa-Montreal triangle and, in the past, has not lent itself easily to being an instrument for regional development. There are, however, some outstanding examples of successful electronics firms outside the central core. There is potential for more regional development of the electronics industry by catering more aggressively to local requirements. This provides for further regional dispersion of the industry without raising conflict over the economic rationale of locational decisions. Moreover, the potential for the greater use of electronics technology to improve productivity in resource extraction and processing indicates that further specialized regional activity may be valuable and desirable.

The Task Force recommends:

- i) that the electronics industry be seen as a vehicle for specialized regional development;
- ii) that regional development policy with respect to the sector focus on the need to build on indigenous strengths and needs; and
- iii) that governments not use grants or procurement policy to artificially induce regional electronics activity to achieve purely short-term employment creation objectives.

The existence of successful electronics firms on both seaboards, as well as in the heart of the prairies, indicates that electronics firms can be viable outside the central core. The encouragement of regionally based electronics industries will permit the industry to maximize its utilization of the intellectual, technical and financial resources available within the various regions of Canada and would strengthen the sector as a national force within the economy.

Electronics can also further contribute to regional development through the location of government laboratories in the regions rather than in Central Canada. This should, however, only be done to the extent it is consistent with the government's Contracting Out policy.

3. Manpower Policies

The electronics industry requires a highly skilled and educated work force and therefore offers attractive possibilities for high-quality employment for Canadians. At the moment, there does not appear to be any major deficiencies in existing training and development programs as far as the federal government is concerned, and the provincial government of Ontario is currently strengthening its apprenticeship program.

Concern does exist, however, as to; (i) the ability of the system to meet future requirements, and (ii) the ability of skilled tradesmen within the system to be sufficiently mobile to fill job vacancies which exist outside their areas of residence.

The Task Force would support a joint industry - labour - government initiative to undertake the following:

- i) an assessment of the available skills and future requirements of the industry;
- ii) an assessment of the capacity of the existing educational and training systems to meet those needs; and
- iii) an assessment of the adequacy of mobility within the skilled trades.

The development of a central registry for manpower requirements would provide the educational and training system with a guideline against which to structure its programs.

Proposals to improve the mobility of skilled tradesmen would address the existing concerns with respect to unemployed skilled workers in one location and job vacancies in another.

4. Export Financing

Members of the Canadian electronics industry, particularly those capable of quoting on major systems abroad, still find that Canadian export financing facilities are often less favorable than those of their competitors from leading industrial countries. Canadian exports could be significantly enhanced if Canadian export finance facilities were more competitive in terms and conditions with those of Japan, the U.S. and EEC countries.

To this end it should be clearly understood that the Export Development Corporation (EDC) should operate as an overt instrument of government policy in support of Canadian exporters.

The Task Force recommends:

- i) The Export Development Corporation be instructed to match financing terms and conditions to those quoted by the export credit agencies of other countries. In the case of interest rates, this may involve a subsidy where internationally quoted rates on government supported export financing are below the cost of EDC borrowings.
- ii) The EDC be instructed to adjust its insurance terms to be fully competitive with those offered by other countries.
- iii) The establishment of a "Third Window" of export financing to Canadian capital projects for use in middle income countries which are too "rich" to justify zero per cent 50 year CIDA financing, but which cannot afford hard EDC financing. Alternatively, greater flexibility in CIDA policy in support of some portion of Canadian capital projects in developing countries, in conjunction with EDC financing of other parts of the same project, could achieve similar results.

Market opportunities, particularly for telecommunications where Canada has demonstrated strong international competitiveness, are likely to experience explosive growth, particularly in the Middle East and in the emerging nations. It is impossible to quantify with precision the additional export opportunities that could be opened up for Canadian companies through better export financing terms, but they are likely to be substantial. Some major contracts could amount to multiples of \$100 million each, and there would be opportunities for smaller sub-systems sales.

5. Foreign Exchange Rate of the Canadian Dollar

The Task Force wishes to emphasize the sensitivity of the electronics industry to changes in the exchange rate. Task Force members feel that at present levels the exchange rate is a realistic reflection of Canada's current cost structure relative to those of other industrialized countries. The Task Force therefore urges the government to pursue monetary and fiscal policies that will ensure that the exchange rate will continue to reflect Canada's true competitive position in world markets. In particular, care should be taken that substantial inflows of capital would not drive up the exchange rate to again place Canadian industry in a non-competitive position.

6. Tariffs and Federal Sales Tax Anomalies

- a) Under the current tariff structure, tariff item 69605-1 permits duty-free importation of electronic instrumentation and test equipment when for use by universities, other educational institutions, hospitals, government and other non-profit research or scientific organizations. This practice places private research laboratories at a disadvantage as well as discouraging the manufacture of such equipment in Canada.

The Task Force recommends that this tariff item be modified appropriately to remove this disadvantage and to permit the Canadian electronics industry to further develop its capability in this area.

- b) The cost of computers in Canada is some 20 per cent higher than in the U.S. A large proportion of this higher cost is accounted for by the customs tariffs and the federal sales tax on computer equipment. This added input cost has important implications for most users of computers in Canada, but in particular for computer service organizations who must compete in Canada against both U.S. based computer service organizations and against the computer operations of the U.S. based parents of Canadian users.

Accordingly, the Task Force recommends that, to alleviate this input cost disadvantage:

- i) The recommendations of the Tariff Board (Reference 150) for removal of tariffs be taken into account in the context of the multilateral trade negotiations.
- ii) Within the context of the current review of the commodity tax structure, consideration be given to the removal of the federal sales tax on data processing equipment.

PART VI

Overall Impact

The Task Force members, on the basis of their extensive personal experience and expertise, are convinced that the mix of policies proposed would bring about the conditions necessary for the industry to grow to its potential. This would have significant benefits for Canada in terms of employment, income, and the balance of trade in electronics. Moreover, stimulated growth of the industry would contribute to a much more rapid advance in national productivity and competitiveness, partly because the industry is already one of the strongest performers in this area and partly because the goods and services it supplies to other industries in turn improve their performance.

It is recognized that the mix of policies and programs sought represents a major commitment of government resources, but the success of the electronics industry cannot be gained by half measures or incremental changes in effort. This applies as much to government's role as it does to the efforts of the individual firms. If government support is to be effective, it must be in the nature of the sustained and massive program outlined in the recommendations. A short-term, incremental approach will limit severely the potential of the industry to develop and likely will lead over time to a gradual weakening of the competitiveness and technological strength of the industry.

ELECTRONIC INDUSTRY TASK FORCE REPORT

APPENDIX I

- TABLE I: Growth in Electronics Output and Use Canada: 1966-1976
- TABLE II: Electronics Industries
International Comparison of Average Annual Growth Rates
- TABLE III: Electronics Industries
International Comparison of Average Annual Contribution
to GDP
- TABLE IV: Electronics Industries
International Trade
- FIGURE 1: Electronic Industry Trade Balance

TABLE I
Growth in Electronics Output and Use
Canada 1966-1976

	(\$ million)		
	1966	1976	% Change
Domestic Market	1,376	3,865	181
Shipments	1,040	2,598	149.8
Exports	215	841	291
Imports	551	2,108	283
Trade Balance	- 336	-1,267	277
Employment	67,917	64,792	-4.6

Source: Statistics Canada

TABLE II
Electronics Industries
International Comparison of Average Annual Growth Rates

Country	1965-1975	1970-1975
Canada	10.9%	12.5%
France	17.2%	25.0%
Japan	23.0%	13.6%
Britain	11.7%	12.7%
U.S.	7.4%	6.5%
West Germany	14.0%	15.1%
Sweden	16.3%	21.0%
World Average	11.6%	10.8%

Source: OECD.

TABLE III
Electronics Industries

International Comparison of Average Annual Contributions to GDP

Country	1965	Average	
		1965-1975	1975
Canada	1.7%	1.7%	1.5%
France	1.6%	1.9%	2.3%
Japan	3.0%	4.5%	4.3%
Britain	2.1%	2.7%	2.8%
U.S.	2.9%	2.9%	2.7%
West Germany	2.1%	2.3%	2.1%
Sweden	1.6%	1.9%	2.3% *

* (final year for Sweden 1973)

Source: OECD

TABLE IV
Electronics Industries
International Trade

Country	Imports as % of ADM*		Exports as % of Shipments		Trade Balance as % of ADM*	
	1965	1975	1965	1975	1965	1975
Canada	36	53.6	20.2	34.8	-19.9	-28.9
U.S.	3.6	13.7	7.9	19.8	4.6	7.7
West Germany	24.3	48.6	37.5	57.8	21	21.7
Britain	21.1	45.1	29.8	46.3	12.3	2.2
France	26.0	32.5	24.3	28.6	-2.3	-5.5
Japan	8.1	7.5	23.7	27.8	20.5	28.0

* Apparent Domestic Market

Source: OECD

BILLIONS US \$

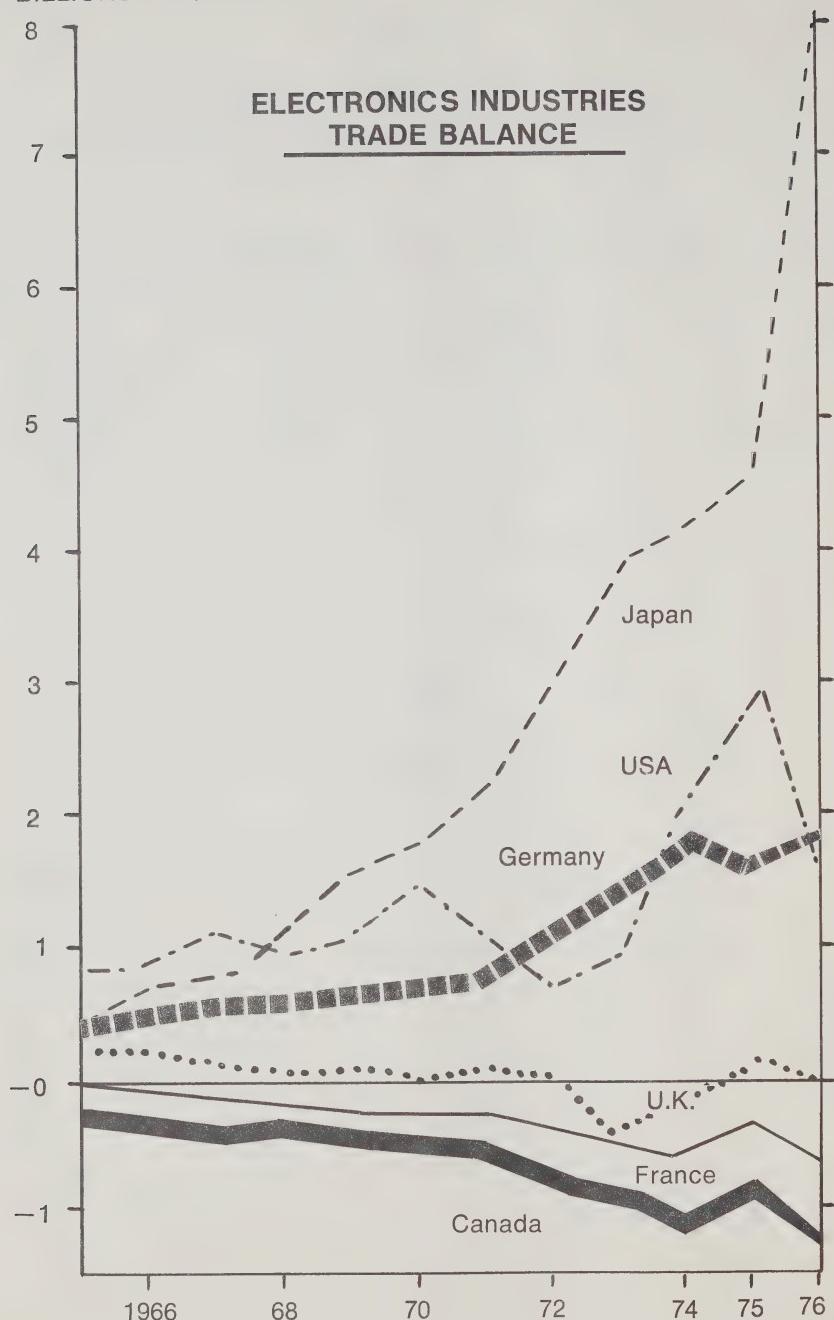


FIG. 1

ELECTRONIC INDUSTRY TASK FORCE REPORT

APPENDIX II

Recommendations Concerning Guidelines for the Corporate Behaviour of
Foreign-Owned Companies and Multinational Enterprises Operating in
Canada.

1. Recommendations Affecting Multinational Enterprises¹
Operating in Canada

1.1 General Policies

The enterprise should:

- (a) ensure that general policies are consistent with those of Canada, giving particular attention to consistency with Canadian aims affecting industrial and regional development, the protection of the environment, the creation of employment opportunities, the promotion of innovation and the transfer of technology;
- (b) favour close co-operation with local community business interests; allow management freedom to exercise competitive
- (c) advantages in both Canadian and offshore markets;
- (d) allow responsible positions to be filled on the basis of individual qualification without discrimination as to nationality, but ensuring that the advantages of this latter aspect are duly balanced.
- (e) ensure that no bribes or other improper benefits are solicited or expected or accepted to gain or retain business.
- (f) ensure that any form of contribution or involvement for political purposes is strictly within the spirit and the letter of Canadian legal requirements.

1.2 Disclosure of Information

The enterprise should:

- (a) publish in a form suited to improving public understanding of the enterprise a sufficient body of factual information on the structure, activities and policies of the enterprise as a whole, having due regard to business confidentiality in a competitive context; such information should clearly reflect the enterprise as having a significant interest in responsible corporate behaviour at all levels and, within reasonable limits, to contribute to the welfare of the communities in which it operates; and
- (b) co-operate fully in providing such supplementary information, particularly of a financial nature, as is required under Canadian corporate disclosure regulations.

¹ These recommendations are modeled after the Organization for Economic Co-operation and Development (OECD) guidelines promulgated in 1976. Consideration is also given to relevant portions of the July, 1975 guidelines of the Canadian Government in Part 2 of this Appendix.

1.3 Competition

The enterprise should:

- (a) refrain from actions which would constitute taking advantage of a dominant market position, by means, for example, of
 - anti-competitive acquisitions,
 - predatory behaviour toward competitors,
 - unreasonable refusal to deal,
 - anti-competitive abuse of industrial property rights,
 - discriminatory (i.e. unreasonably differentiated) pricing and using such pricing transactions between affiliated enterprises as a means of adversely affecting competition outside these enterprises;
- (b) allow purchasers, distributors and licensees freedom to resell, export, purchase and develop their operations consistent with law, trade conditions, the need for specialization with sound commercial practice;
- (c) refrain from participating in or otherwise purposely strengthening the restrictive effects of international or domestic cartels or restrictive agreements which adversely affect or eliminate competition;
- (d) be ready to consult and co-operate, including the provision of information with authorities whose interests are directly affected in regard to competition issues or investigations. Provision of information should be in accordance with safeguards normally applicable in this field.

1.4 Financing

Enterprises should, in managing the financial and commercial operations of their activities, and especially their liquid foreign assets and liabilities, take into consideration the established objectives of the countries in which they operate regarding balance of payments and credit policies.

1.5 Taxation

The enterprise should:

- (a) upon request of the taxation authorities provide, in accordance with national laws, the information necessary to determine correctly the taxes to be assessed in connection with its operations; and
- (b) refrain from using such instruments as transfer pricing, which do not conform an arm's length standard, and from modifying such instruments in ways contrary to the national laws on which the tax base is established.

1.6 Employment and Industrial Relations

The enterprise should:

- (a) respect the right of its employees, to be represented by trade unions and other bona fide organizations of employees, and engaged in constructive negotiations, either individually or through employers' associations, with such employee organizations with a view to reaching agreements on employment conditions;
- (b) provide to representatives of employees where this accords with local law and practice, information which enables them to obtain a true and fair view of the performance of the entity or, where appropriate, the enterprise as a whole;
- (c) observe standards of employment and industrial relations not less favourable than those observed by comparable employers in the host country;
- (d) to the greatest extent practicable, utilize, train and prepare for upgrading members of the local labour force in co-operation with representatives of its employees and, where appropriate, the relevant governmental authorities;
- (e) in considering change in its operations which would have major effects upon the livelihood of its employees, particularly in the case of the closure of an entity involving collective lay-offs or dismissals, provide reasonable notice of such changes to representatives of the employees, and, where appropriate, to the relevant governmental authorities, and co-operate with the employee representatives and appropriate governmental authorities so as to mitigate, to the maximum extent practicable, adverse effects;
- (f) implement employment policies including hiring, discharging, paying, promoting and training without discrimination;
- (g) in the context of bona fide negotiations with representatives of employees on conditions of employment, or while employees are exercising a right to organize, not threaten to utilize a capacity to transfer the whole or part of an operating unit from the country concerned in order to influence unfairly those negotiations or to hinder the exercise of a right to organize; and
- (h) enable authorized representatives of its employees to conduct negotiations on collective bargaining or labour-management relations issues with representatives of management who are authorized to take decisions on the matters under negotiations.

1.7 Science and Technology

The enterprise should:

- (a) endeavour to ensure that its activities fit satisfactorily into the scientific and technological policies and plans of the

countries in which it operates, and contribute to the development of national scientific and technological capacities, including as far as appropriate the establishment and improvement in host countries of its capacity to innovate;

- (b) to the fullest extent practicable, adopt in the course of its business activities, practices which permit the rapid diffusion of technologies with due regard to the protection of industrial and intellectual property rights; and
- (c) when granting licences for the use of industrial property rights or when otherwise transferring technology do so on reasonable terms and conditions.

2. Guidelines to Accommodate Distinctively Canadian Requirements²

- 2.1 Pursue a high degree of autonomy and initiatives in the exercise of decision-making and risk-taking functions, including innovative activity and the marketing of any resulting new products.
- 2.2 Develop, as an integral part of the Canadian operation, an autonomous capability for technological innovation, including research, development, engineering, industrial design and preproduction activities; and for production marketing, purchasing and accounting.
- 2.3 Retain in Canada a sufficient share of earnings to give strong financial support of the growth and entrepreneurial potential of the Canadian operation, having in mind a fair return to shareholders on capital invested.
- 2.4 Demonstrate responsibility for enhancing its international competitiveness through the build-up of innovative and product development resources. Particular focus should be on Canadian market needs offering a viable basis for efficient product specialization and international market development.
- 2.5 Aggressively pursue and develop market opportunities throughout international markets, as well as in Canada.
- 2.6 Extend the processing in Canada of natural resource products to the maximum extent feasible on an economic basis.
- 2.7 Search out and develop economic sources of supply in Canada for domestically produced goods and for professional and other services.

2 These guidelines, with some modifications and/or clarifications were taken from the revised set of "Principles for International Business Conduct" recommended for foreign controlled firms in Canada by the Canadian Government.

- 2.8 Foster a Canadian outlook within management, as well as enlarged career opportunities within Canada, by promoting Canadians to senior and middle management positions, by assisting this process with an effective management training program, and by including a majority of Canadians on boards of directors of all Canadian companies, in accordance with the spirit of federal legislative initiatives.
- 2.9 Create a financial structure that provides where possible opportunity for substantial equity participation in the Canadian enterprise by the Canadian public.
- 2.10 Pursue a pricing policy designed to assure a fair and reasonable return to the company for all goods and services sold abroad, including sales to parent companies and other affiliates abroad, pursue a pricing policy designed to assure that the terms are at least as favourable as those offered by other suppliers.
- 2.11 Give appropriate support to recognized national objectives and established government programs, while refusing any direct or indirect pressure from foreign governments or associated companies to act in a contrary manner.
- 2.12 Participate in Canadian social and cultural life and support those institutions that are concerned with the intellectual, social and cultural advancement of the Canadian community.
- 2.13 Endeavour to ensure that access to foreign resources, including technology and know-how, is not associated with terms and conditions that restrain the firm from observing these principles.

3. Conclusion

The overriding consideration is that both international and domestic enterprises should be governed by rules that apply equally in like situations and that there should not be any preferential bias in the application of the rules.

SECTOR PROFILE

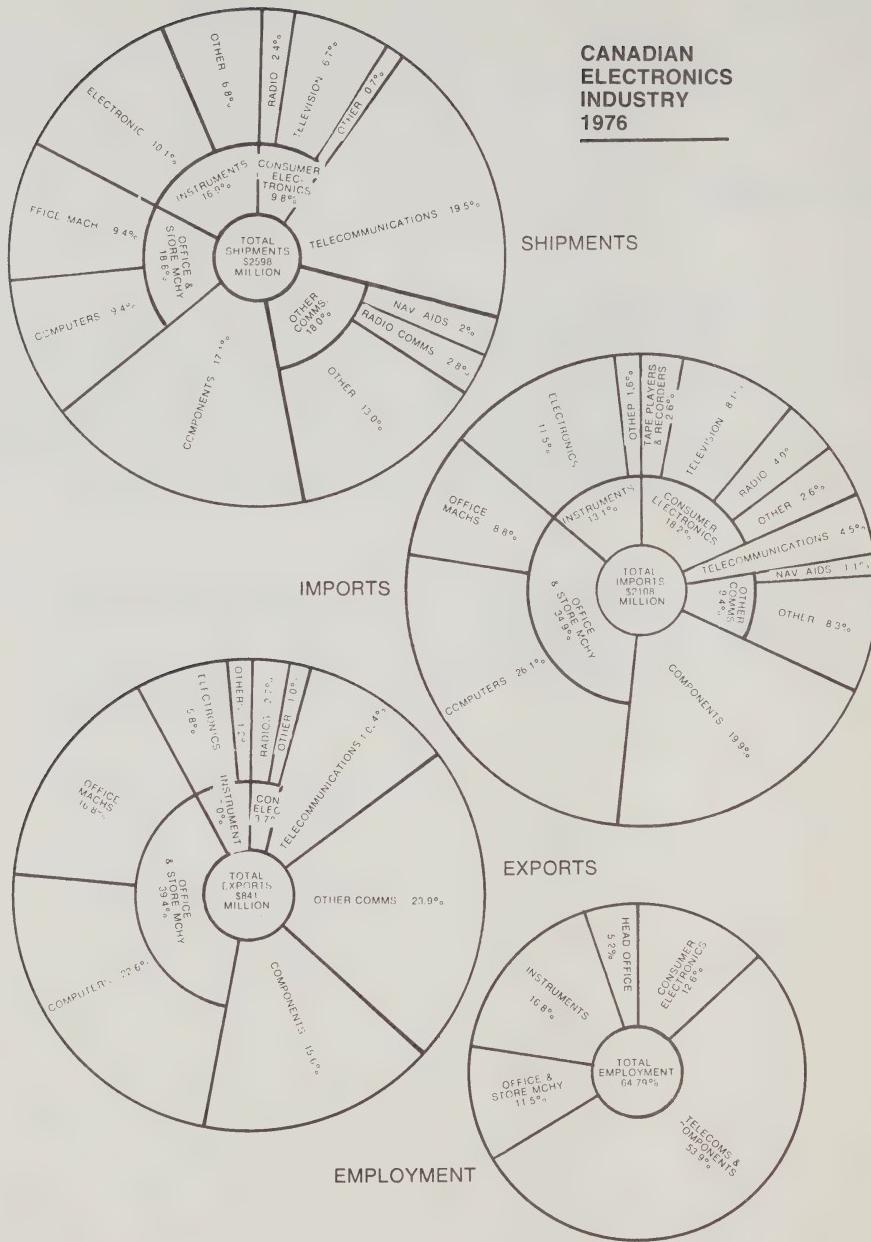
THE CANADIAN ELECTRONICS INDUSTRY

The following profile of the Canadian Electronics Industry was developed by the Sector Task Force on the Canadian Electronics Industry from a profile prepared by the federal Department of Industry, Trade and Commerce.

INTRODUCTION

The Canadian electronics industry encompasses a large number of firms (more than 700) producing a diverse range of products. While all companies draw on essentially the same core of electronics technology, differences in the way in which this technology is applied make direct comparisons among them difficult. In fact, differences among sub-sectors of the industry are often more revealing than similarities in explaining the industry's current status and future prospects. This report is therefore divided into two main sections. The first considers the general characteristics of the industry and how it compares with the electronics industry in other industrialized countries. The second section considers the problems and prospects in each of the industry's main sub-sectors.

CANADIAN
ELECTRONICS
INDUSTRY
1976



SECTION I

THE ELECTRONICS INDUSTRY IN GENERAL

THE ELECTRONICS INDUSTRY IN GENERAL

Industry Development Over the Period 1966-1976

During the period between 1966 and 1976, the use and production of electronics products grew as indicated in the following table:

TABLE I
Growth in Electronics Output and Use
Canada 1966-1976

	1966	1976	(\$ million) % Change
Domestic Market	1,376	3,865	181
Shipments	1,040	2,598	149.8
Exports	215	841	291
Imports	551	2,108	283
Trade Balance	-336	-1,267	277
Employment	67,917	64,792	-4.6

Source: Statistics Canada

As a point of reference, Canadian gross national product grew during the same period by 207 per cent.

During the past decade the Canadian electronics industry, in common with the industry in most countries, became much more international in character. Thus, while production and growth in the domestic market lagged behind increases in GNP, both exports and imports grew at a substantially faster rate. (Comparisons with GNP must be approached with caution because of variation in the rate of inflation among different sectors of the economy. It is probable that real growth in electronics was higher in relation to GNP than these figures suggest because of the influence of electronics technology in keeping prices down.)

Although the rate of growth in exports appears to have more than kept pace with the rate of growth in imports, the absolute level of Canada's deficit in electronics products more than trebled between 1966 and 1976. Imports now supply 54 per cent of the Canadian market compared with 40 per cent in 1966. At the same time, exports have grown from 21 per cent of shipments in 1965 to 32 per cent of shipments in 1976.

The internationalization of the Canadian electronics industry apparently suggests an industry that is becoming more internationally competitive. However, two factors give cause for concern. First, the jump in exports as a percentage of shipments took place between 1966 and 1970. Since then, the momentum seems to have been lost with exports remaining at about 30 per cent of shipments. Most other countries have continued to export a growing share of their shipments. Second, while exports and imports have grown at about the same rate, exports have grown from a much smaller absolute base and Canada's trade imbalance has therefore continued to grow substantially (see Chart I). For every one dollar increase in exports from Canada there has been almost \$2.50 increase in imports.

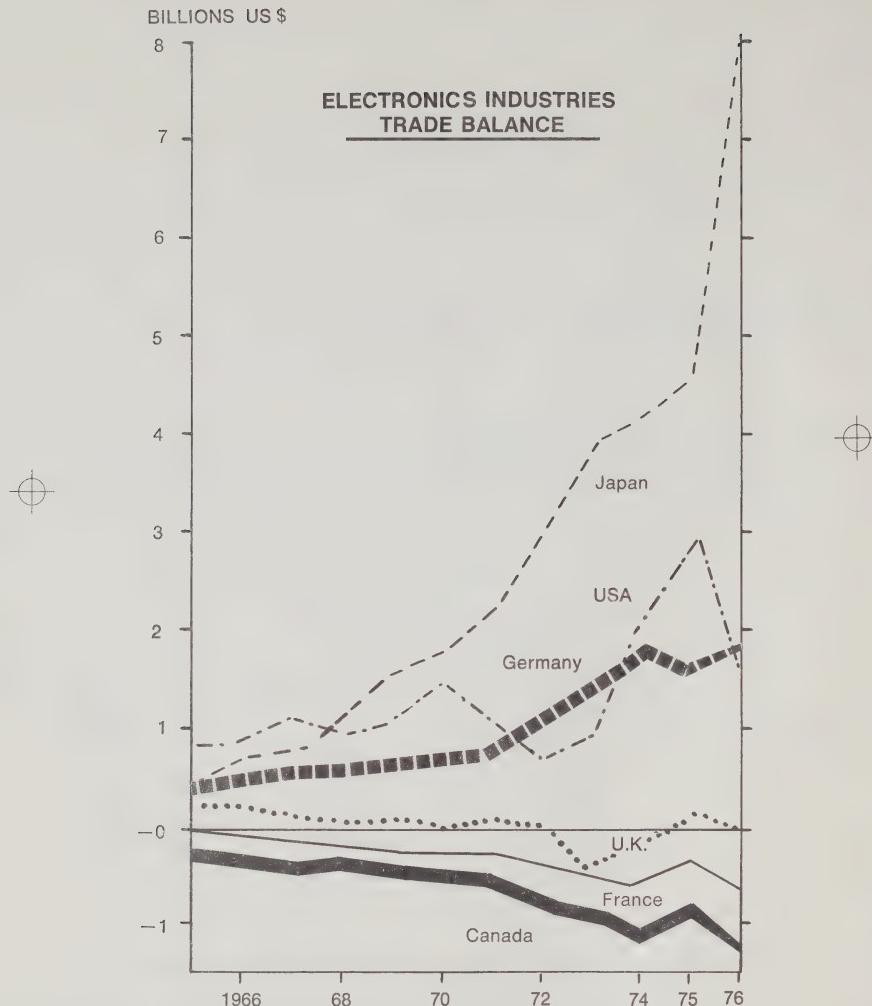


FIG. 1

Employment in the Canadian electronics industry reached a high point in 1969 when it stood at 84,500. Since then it has steadily declined to the point where 1976 employment was 4.6 per cent less than in 1966. Because of productivity increases, the industry's output continued to rise.

Some Growth Comparisons

The world's electronics industries have experienced rapid growth over the last 30 years, exhibiting an average annual growth in production (in current \$) of 11.6 per cent from 1965 to 1975, and 10.8 per cent from 1970 to 1975. Currently, the world electronics market is estimated at approximately \$100 billion, and can be expected to increase at an annual average rate of at least 10 per cent in real terms through to 1980.

Electronics production is heavily concentrated in industrialized countries with 85 per cent of output supplied by the U.S., Japan and Western Europe (principally Britain, France and West Germany). Canada is a minor producer, accounting for only 2.4 per cent of world output. In the last five to seven years developing countries have begun to make their presence felt, particularly in the manufacture of such products as consumer electronics and components.

In terms of output, the U.S. led world electronics production in 1975 with \$40.4 billion, followed by Japan with \$21.3 billion, West Germany with \$9.0 billion, Britain with \$6.4 billion and France with \$7.8 billion. The value of shipments by Canadian electronics manufacturers in 1975 was \$2.4 billion. From 1967 to 1975 the ranking of the referenced countries in electronics production remained unchanged, Canada ranking below France.

The average yearly growth rate of the Canadian electronics industry relative to those of some other major nations is tabulated below:

TABLE II
Electronics Industries
Average Annual Growth Rates

Country	1965-1975	1970-1975
Canada	10.9%	12.5%
France	17.2%	25.0%
Japan	23.0%	13.6%
Britain	11.7%	12.7%
U.S.	7.4%	6.5%
West Germany	14.0%	15.1%
Sweden	16.3%	21.0%
World Average	11.6%	10.8%

Source: OECD.

Over the last 10 years only the United States has had a slower rate of growth than Canada; but, from a twelvefold larger base. Even with somewhat slower growth than other countries, the annual absolute increase in U.S. electronics output is larger than total Canadian output.

Between 1965 and 1975 Canada was almost alone in failing to increase the share of national output accounted for by its electronics industry. During this period, electronics production in Canada averaged 1.7 per cent of Gross Domestic Product (GDP) while in all other countries it increased as shown in the following table:

TABLE III
Average Annual Contributions to GDP

Country	1965	Average	
		1965-1975	1975
Canada	1.7%	1.7%	1.5%
France	1.6%	1.9%	2.3%
Japan	3.0%	4.5%	4.3%
Britain	2.1%	2.7%	2.8%
U.S.	2.9%	2.9%	2.7%
West Germany	2.1%	2.3%	2.1%
Sweden	1.6%	1.9%	2.3%*

**(final year for Sweden 1973)*

Source: OECD

The Canadian domestic market for electronics products is considerably smaller than the markets in other major industrialized countries. In 1975, for example, Canadian demand was \$3.4 billion compared with \$37.5 billion in the United States; \$16.6 billion in Japan and \$8.2 billion in France.

During the period of 1965-1975 inclusive, the Canadian domestic market was also amongst the slowest growing, averaging an annual rate of growth of 12.2 per cent. Only the United States, with an average rate of growth of 7.1 per cent a year during the same period, grew more slowly. Market growth in other industrialized countries ranged between 13.9 per cent a year in Germany to 22.5 per cent in Japan, illustrating the tendency of these countries to catch up with the U.S.

As Canada and the United States had the slowest rate of growth in production, it might be concluded that their poor performance was due to sluggish growth in their home markets. Also, it could be argued that rapid growth of production in Europe and Japan was based on rapid growth of their domestic markets. However, as was mentioned earlier, in all countries, including Canada, there was a rapid rate of growth in exports and imports during the last decade resulting in a greater degree of international specialization. Rather than building their growth on the domestic market, each of the industrialized countries (except Japan) seems to have given up a significant share of its own market in return for increased sales in foreign markets. In effect, the battle amongst industrialized countries over the last decade became one of trying to expand exports at a faster rate than imports. The relative success of major industrialized countries in achieving this end is shown in the following table:

TABLE IV
Electronics — International Trade

Country	Imports as % of ADM*		Exports as % of Shipments		Trade Balance as % of ADM*	
	1965	1975	1965	1975	1965	1975
Canada	36	53.6	20.2	34.8	-19.9	-28.9
U.S.	3.6	13.7	7.9	19.8	4.6	7.7
West Germany	24.3	48.6	37.5	57.8	21	21.7
Britain	21.1	45.1	29.8	46.3	12.3	2.2
France	26.0	32.5	24.3	28.6	-2.3	-5.5
Japan	8.1	7.5	23.7	27.8	20.5	28.0

*Apparent Domestic Market

Source: OECD.

It is notable that, except for Japan, France and the United States, levels of import penetration in the range of 40 per cent to 50 per cent are not now uncommon. Even in the case of the United States and Japan, which have more than 50 per cent of world demand, the absolute levels of imports are very high. Thus, with some important exceptions to be noted below, the electronics industry is now very much an international industry.

Over the last decade the winners of the international trade battle clearly have been the United States, Germany and Japan and not Canada, Britain and France. In each case winners were obviously able to increase exports more quickly than imports but the approaches they followed were different. Unlike other countries, Japan seems to have given most emphasis to preventing import penetration. Its export growth, while large in volume terms, increased very slowly as a share of shipments, in fact the slowest of any industrialized country. Japan's exports as a percentage of its total shipments are no larger than Canada's. Germany, on the other hand, has given little attention to stemming imports but relied instead on a significant export drive. Its industry is by far the most export-oriented in the world.

In the United States the pattern has been different again. With virtual self-sufficiency in electronics more than a decade ago, growth in exports and imports has been both more balanced and more gradual. Until recently, the United States has neither felt the need to hold the lid on imports nor give a major push to exports. This quiescent attitude is now changing. The United States is concerned about the increasing penetration of its market by Japanese consumer electronic products, particularly colour TV. Further, there is concern that the developing strength of Japanese manufacture of large scale integrated circuits may pose a threat to the U.S. position in this field. Also, there are indications that the U.S. government and industry are making an appraisal of their policies regarding technology transfer and its impact on international trade of the high technology industries, including electronics.

Canada, Britain and France, on the other hand, have found themselves in essentially the same position. Imports have been allowed to flow in and there has been an impressive increase in the export-orientation of domestic producers. However, exports were not able to increase sufficiently to offset the growth in imports.

In this respect Canada has fared worse than any of the other industrialized countries reviewed. While the Canadian electronics industry was able to increase significantly the proportion of its shipments going to exports, it still lags far behind most countries in the degree to which it has found a place in export markets. At the same time the degree of import penetration is amongst the highest in the industrialized world.

Internationalization may proceed somewhat more slowly in the future, if only because the industry is now so internationalized. Nevertheless, competition could, if anything, be keener since the fortunes of so many producers now depend upon their performance in world markets.

Japan, for example, is likely to become a more important competitor over the next decade as it seeks to broaden the base of its export drive which has hitherto depended mainly on consumer electronics. Japan's electronics industry has developed sufficient strength to take on foreign competitors in a number of new areas such as computers and process control. This is the announced policy of the Japanese government and industry. In 1975, MITI initiated development of Very Large Scale Integrated Circuits (VLSI) by five computer manufacturers: Toshiba, Nippon, Fujitsu, Hitachi and Mitsubishi. This forms part of a comprehensive plan, conceived by MITI and the computer industry, to develop new computers to effectively compete against IBM's future system.

Further, in 1976, MITI established a joint venture software company, Joint Systems Development Corp., with 17 leading software companies of Japan. Investors include nine Japanese banks, including the Japan Development Bank.

Japan's success in building upon a protected domestic market has not gone unnoticed in other countries. While Europe has been relatively open to imports of electronics over the last 10 years, there are definite signs that certain European countries will attempt to close their markets in selected areas, particularly telecommunications, computers and integrated circuits. The attempts in both Britain and France to build a domestic computer industry are already known. While there have been some spectacular failures, these attempts still continue, backed by substantial government support in terms of both R&D and procurement. West Germany has also announced recently a special multi-million dollar program of support for domestic computer production.

In telecommunications, procurement policy has long been used in Europe and Japan to limit market access by external suppliers since most telephone systems are government-owned. It is now apparent, at least in France, that procurement policy will be allied with other government policies to strengthen domestic producers — nationalization of foreign producers, special export drives, equity financing, R&D support.

For example, in May 1976, as part of President Valéry Giscard d'Estaing's plan to bring key high-technology industries under French control, International Telephone and Telegraph Corporation and Sweden's L.M. Ericsson Group were persuaded to sell control of their telephone equipment subsidiaries to Thomson-CSF. The state-operated Post and Telecommunications Office (PTT) is embarking on a multi-billion dollar expenditure over the next five years to upgrade the telecommunications system in France. Thomson-CSF was chosen as the national supplier and the acquisitions of the ITT and Ericsson subsidiaries provided CSF with the major share of the French telephone market. In considering the technology requirements, advanced electronics switching systems offered by Canada's Northern Telecom and Japan's Nippon Electric were rejected in preference to a development program by CSF. This requires a large and expensive R&D investment committed to the development of an indigenous technology.

Finally, there is a growing awareness by governments throughout the world that the future of electronics for at least the next 10 to 15 years lies with the integrated circuit. It is clear even now that the integrated circuit will have a more profound effect on electronics than the transistor which revolutionized the electronics industry 25 years ago. While the United States has a strong lead in integrated circuits, Japanese producers have begun a major effort to close the gap. European countries are beginning to provide support to their producers to establish a jointly owned integrated circuits producer to challenge the Americans and Japanese. Canada's only major producer of integrated circuits, which was heavily supported by government, went out of business three years ago.

STRUCTURE AND GENERAL CHARACTERISTICS

Location

There are more than 700 firms in Canada making electronics products. At least 80 per cent of these firms are in the provinces of Quebec and Ontario, mainly in major metropolitan areas. They produce more than 90 per cent of Canadian electronics output. The concentration in major metropolitan centres is particularly true for the high technology aspects of the industry where close proximity to a supporting technological infrastructure and a skilled labour pool is necessary. This pattern is similar to that in most other major producing countries where the industry tends to cluster in certain localities.

There is however a degree of mobility in electronics which could lead to more regional development of the industry in Canada. There are, for example, some successful electronics firms outside the major concentrations — on both seaboards of Canada and in the heart of the prairies. The potential for more of these may be significant and could be spurred by a greater use of electronics technology to improve productivity in the resource extraction and processing industries for example. In this sense, regional development of the electronics industry on a specialized basis, building on indigenous needs and strengths, would be desirable and beneficial. The extent to which this can be realized will depend upon the demand or market pull and the existence or further development of the supporting infrastructure and skilled manpower in the regions.

Size

By global standards, the size of most Canadian electronics firms is extremely small. As the following table indicates, almost 70 per cent (491) of companies have sales of less than \$1 million and only eight per cent (29) have annual sales in excess of \$25 million.

TABLE V
Distribution of Companies, Sales and Employment
by Company Size (1975)*

Annual Sales (\$millions)	No. of Companies (Units)	Total Sales (\$millions)	Employ- ment (Units)	% of Total Sales	% of Employ- ment
0 - 1	491	91	5,350	3	6
1 - 50	213	1,508	50,950	46	57
50 - 200	7	680	13,800	21	16
200 - 1000	1	971	19,000	30	21
Total	712	3,250	89,100	100	100

Source: Department of Industry, Trade and Commerce.

**(data includes manufacture and distribution of non-electronics products as well)*

Even Canada's largest company, Northern Telecom, which had sales of more than \$1 billion in 1976, is only medium-sized by international standards. Moreover, the one billion dollars sales figure includes non-electronic items such as wire and cable. Throughout the world, there are more than 30 electronics firms larger than Northern, 15 of which each have sales greater than the total domestic demand for electronics products in Canada. The total sales of these companies also include more than electronics products but the competitive challenge presented by them is no less for that; their large corporate scale gives them formidable marketing advantages and great financial strength.

Nevertheless, Northern, with 30 per cent of total Canadian industry sales, is several times larger than the next seven companies, the combined sales of which amount to only 21 per cent of the industry total. This significant decline in company size continues throughout the industry and the next 45 per cent of total industry revenue is provided by 213 companies. The remaining 491 companies (70 per cent) provide only three per cent (\$91 million) of the industry's sales.

Research and Development

The industry is the largest industrial employer of technical and scientific manpower in Canada and spends more on research and development than any other industrial sector. Roughly 25 per cent of industrial R&D expenditures and employment are accounted for by the electronics industry. The industry spends on average four to five per cent of sales on R&D, a figure greatly eclipsing that of all other industries which spend an average of one per cent of sales on R&D. As might be expected, the

industry spends far more per employed worker on R&D (an average of \$1,100 in 1971) than any other industry (the all-industry average in 1971 was \$355). Again this reflects, in general, the pattern in other industrialized countries. In Britain, for example, 50 per cent of all industrial R&D is carried out by the electronics and aerospace industries. In the United States 20 to 25 per cent of industrial research is performed by the electronics industry. The industry is, therefore, pre-eminently knowledge-intensive and the object of extensive government support in many industrialized countries as these countries attempt to develop a comparative technological advantage.

The governments of all industrialized countries, including Canada, recognizing the importance of R&D to the electronics industry, have channelled large sums of money into training technical manpower and supporting industrial R&D. (In Europe and the United States, roughly 50 per cent of industrial R&D is supported either directly or indirectly by governments.) While there are many reasons for special R&D support such as national prestige and defence requirements, chief among them is the recognition that traditional measures of government assistance to industry are often not as helpful to high-technology industries as they are to others.

For example, although R&D expenditures have much in common with investment in plant and equipment, capital cost allowances are frequently of little value to electronics companies which often have only relatively small amounts of capital invested in physical facilities. Moreover, given the long gestation period for many R&D projects — five to seven years of research and development before production begins is not uncommon — special short-term tax credits or tax relief measures are unlikely to have major influence on electronics firms. Therefore, just as special exploration and depreciation allowances have been used in the unique circumstances of the natural resource industries, so have special R&D support measures been designed by governments for the unique requirements of high-technology industries including electronics. With the levels of support now available by national governments, electronics competition is as much between governments as it is between the companies themselves.

Foreign Ownership

While only 20 per cent of Canadian electronics firms are foreign-owned, these account for 55 per cent of the industry's sales. If Northern's sales are excluded, foreign-owned firms account for 80 per cent of sales. As would be expected on the basis of these figures, foreign ownership controls most of the significant sized firms in the industry — 72 of the 100 largest firms are foreign-owned. No other industrialized country has such a high degree of foreign ownership of its electronics industry.

An Assessment of the Aggregate Data

Based on aggregate data for the last 10 years, it might be concluded that the performance of the Canadian electronics industry has been satisfactory as the industry was able to more or less maintain its share of world markets. This conclusion would, however, be erroneous, particularly if it were assumed that the Canadian industry could count on continuing to maintain its share of world output.

It should first be noted that Canada was able to maintain its share of world markets by exceeding the average rate of growth in world output over the period 1970 to 1975, an average greatly influenced by the sluggish performance of the industry in the United States. The United States had by far the slowest growth in electronics output of any industrialized country and Canada had the second poorest performance. Thus the major producers were able to increase their share of world markets at the expense of the United States.

Secondly, most major producers were able to increase the share of GDP accounted for by the production of electronics products. If it is true that for industrialized countries an increasing share of output should be derived from certain sectors — particularly high technology sectors like electronics — Canada's performance over the last 10 years has been less than satisfactory. On the other hand, some sub-sectors have performed much better than others. In Canada, for example, the telecommunications sub-sector has developed strongly and in the U.S. the growth in the manufacture of semiconductors and integrated circuits has exceeded that of all other countries.

Thirdly, while the rate of growth of the Canadian electronics sector exceeded the world average, it was materially assisted during the last decade by rapid growth in consumer electronics, primarily colour television, and by exports of defence equipment to the United States. Both of these markets, as will be explained below, are unlikely to provide the same impetus for growth as in the last decade.

Fourthly, it should be noted that the growth of the Canadian electronics industry has taken place behind a moderately high level of tariff protection. Even with an average tariff level of 15 per cent, the industry has lost ground in its own market and has not been able to make up the gap in the export market.

Finally, during the last decade, most electronics firms in Canada had a wage advantage compared with their American counterparts. This wage advantage has now been lost. There is concern in the industry that the Canadian business climate, in general, has become significantly less favourable than is the climate in other countries, particularly the United States. In addition to being disturbed about the general business climate, many Canadian electronics manufacturers are concerned that governments in Canada have not singled out their electronics industry for special support to the same extent as have the governments of other countries.

There are indications at the sub-sector level that these influences are already being felt and that the performance of the Canadian industry is beginning to deteriorate.

SECTION II

THE ELECTRONICS INDUSTRY — SUB-SECTORS

THE ELECTRONICS INDUSTRY — SUB-SECTORS

There are six main sub-sectors in the Canadian electronics industry: (1) consumer products; (2) components; (3) telecommunications; (4) other communications; (5) computers and office equipment; and (6) control and instrumentation. With the exception of Northern Telecom in the telecommunications sub-sector, two distinct features are common to each sub-sector — foreign ownership and/or small firm size. Nevertheless, each of the sub-sectors differs in important ways from the others, particularly with respect to the impact of ownership and size.

In addition to the above six major sub-sectors, there is an activity which ties together the technologies of communications, computers and instrumentation to provide integrated systems for solving complex problems of maintaining control in the fields of industrial processing, commercial transactions and defence. This activity is termed systems electronics, is relatively new in Canada and offers potential for the future development of the electronics industry. This subject is discussed in greater depth later in this paper.

PRODUCT SUB-SECTORS

Consumer Products

TABLE VI
Growth in Consumer Products Output and Use
Canada 1966-1976
(\$ million)

	1966	1976	% Change
Domestic Market	211	608	188.2
Shipments	184	255	38.6
Exports	20	31	55.0
Imports	47	384	717.0
Trade Balance	-27	-353	1,207.4

Source: Statistics Canada

Output of the Canadian consumer electronics sub-sector is approximately \$250 million annually. Of this, 75 per cent is accounted for by TV manufacturing, the remainder is production of mobile radios, low-priced novelty radios and various items of specialized audio equipment. Consumer electronics products are extremely price-sensitive and in most cases competitiveness depends on large-scale production. This is particularly so in the case of TV production. In 1976 there were 10 colour television manufacturers in Canada, only one of which was and remains Canadian-owned. The average annual production run was 50,000 sets and the largest company produced slightly more than 100,000 sets a year. Minimum competitive plant scale is estimated to be 300,000 sets annually while many producers in foreign countries have plants capable of producing 1,000,000 sets a year.

Three years ago, it became apparent that TV manufacturing was headed towards collapse. Even with a 15 per cent tariff, imports were making large inroads in the Canadian market increasing their share from 30 per cent in 1970 to 45 per cent in 1974. In these circumstances government and industry explored a number of options for the future.

- Two avenues to create large-scale facilities were discussed with Canadian-based manufacturers:
- the creation of a joint production facility (a core manufacturer) by two or more major Canadian-based producers;
 - the establishment in Canada by a multinational firm of a production facility to supply its North American requirements for most models.

Since there is only one Canadian-owned producer, relatively small scale by international standards, both options required the participation of multinational firms to assure sufficient market share and access to advanced research and development for the next generation of products.

These efforts failed totally. The first option was rejected, in large part, because of the reluctance of foreign-owned firms to join forces in Canada when they are competitors in the rest of the world. U.S. antitrust legislation was also a powerful factor. The second option was rejected because all firms canvassed stated they had more attractive alternatives than Canada for supplying their North American requirements.

In these circumstances, rather than attempting to rationalize the *industry*, a program was developed to rationalize the activities of individual *firms* and give them time to adjust to new activities. The program, which was introduced on January 1, 1977, provides for:

- duty remission on imported television sets (the level of remission to be determined by the extent to which domestic production exceeds the level of production in the base period 1974–1975);
- no reduction to tariffs on TV sets until the end of 1981;
- withdrawal of the General Preferential Tariff and British Preferential Tariff on certain colour TV sets until 1980.

These measures are designed to encourage manufacturers to specialize on the production of only one model of TV receiver and thereby lower costs. The excess of their production to their requirements for sale in Canada would be exported to affiliates. Imports would replace models no longer manufactured in Canada because of rationalization.

It is unlikely that these measures will provide sufficient cost savings in the longer run for Canadian manufacturers to continue the production of TV sets much beyond the early 1980s. The duty remission scheme, therefore, also applies in cases where a company has an approved business plan to diversify production in Canada to other products.

It is too early to predict with confidence the results the scheme is likely to produce. Some portions of the sub-sector may possibly survive, but only if individual corporate (rather than industry) rationalization schemes are so successful that individual plants in Canada become sufficiently cost effective to continue to be of value to parent companies even after the expiration of the duty remission scheme.

In essence, the colour TV situation is a classic example of an industry with too many firms attempting to compete in a very small market behind high tariff protection. This sub-sector of the industry cannot survive in its present form. The industry must, therefore, adapt to a new set of conditions. Whether it can do so remains an open question at this time.

Components

TABLE VII
Growth in Components Output and Use
Canada 1968–1976
(\$ millions)

	1968	1976	% Change
Domestic Market	351	732	108.5
Shipments	268	443	65.3
Exports	55	131	138
Imports	138	420	204
Trade Balance	–83	–289	–248

Source: Disaggregation of Statistics Canada data for SIC 335 (Telecommunications)

The term "components" covers a wide range of products which do not lend themselves readily to treatment as a homogeneous grouping. Products range in complexity from very large-scale integrated circuits and colour television tubes to simple resistors or capacitors. Production techniques, the technology and scale required, and the markets they serve often vary significantly.

In general, however, the manufacture of components requires large-scale production which does not exist in Canada. For integrated circuits, which are increasingly replacing discrete components, volume production is required to support heavy R&D expenditures. For other types of components, including discrete components, scale of production is important simply to remain price competitive.

Canada's prospects in both areas are not promising. The attempt to create a world scale integrated circuit facility — Micro-Systems International — was a failure. While possibilities remain open in this area, Canadian experience and that of other integrated circuit manufacturers is that this is a very high risk and costly activity where the probability of failure outweighs the chances of success. Only countries like the United States, which can support a number of firms, stand a reasonable prospect of maintaining a healthy semi-conductor industry. For a small country like Canada, which can afford only one or two ventures, the probability of success is much lower. An alternative which Europe appears to be following, is assured government support.

Neither can Canada hope to compete in the production of high-volume discrete components, the production of which has migrated from industrialized countries to developing countries, primarily in Southeast Asia. Their low labour costs and the entrenched position of existing suppliers present virtually insurmountable obstacles to Canada and, indeed, all other high wage industrialized countries.

There are, however, certain segments of the components industry which can compete in supplying local end-users with relatively small quantities of highly specialized or custom-made components. For example, this is being demonstrated by some Canadian companies in the manufacture of printed circuit boards, quartz crystals and selected semi-conductors and integrated circuits. Companies in this segment of the components industry depend upon a healthy end-user industry. This has profound implications for the types of measures aimed specifically at the problems currently faced by independent components producers. Their future depends upon the future of the rest of the electronics industry in general.

A strong end-user industry will not, however, give any assurances to most of the components industry's activity. In recent years the largest volume of components production in Canada has come from three sources: Micro-Systems International, IBM and the RCA colour television picture tube plant. The first two were largely responsible for Canada's impressive components export performance over the last decade. However, Micro-Systems has now ceased operations. There are a number of other component manufacturers which are facing serious difficulties.

The prospects for the components sub-sector have recently been examined by a joint Industry/ITC Task Force organized by the Electrical and Electronics Manufacturers' Association of Canada. The principal findings of this study can be summarized as follows:

The firms' activities are too diverse to lend themselves to a solution which could be applied to the total sub-sector. While the statistical analysis reveals a downward trend for the group as a whole this is not meaningful because there are some elements of it, and some companies, which show impressive growth and encouraging future prospects. On the other hand, there are some other companies which are currently facing serious difficulties and their outlook is not promising. It is also recognized that many companies sell most of their output to equipment manufacturers in other sub-sectors and should be considered as part of those sub-sectors, such as telecommunications and appliances for example. The remaining companies are not so specifically identified with other sub-sectors and some of these are in difficulty.

Accordingly, it seems appropriate for industry and government to address problems on a company-by-company basis taking into consideration that the output of components manufacturers are the inputs to end-product manufacturers and also the specialized nature of some components manufacturers in products and markets.

Telecommunications

TABLE VIII
Growth in Telecommunications Output and Use
Canada 1968-1976
(\$ millions)

	1968	1976	% Change
Domestic Market	145	512	253
Shipments	162	506	212
Exports	49	89	82
Imports	32	95	197
Trade Balance	17	-6	-135

Source: Disaggregation of Statistics Canada data for SIC 335 (Telecommunications)

This sub-sector is the strongest in the Canadian electronics industry and contains its largest firm, Northern Telecom. The development of Canada's communications networks has been greatly facilitated by a responsive, competitive and progressive manufacturing industry which has produced equipment and systems to meet the carriers' special needs.

Perhaps more than any other country, Canada has been historically dependent upon transportation and communications to meet a number of uniquely Canadian needs arising from the geographical distribution of a small population over a large land mass.

Given its size and existing strength, the future of Canada's telecommunications industry lies with Northern Telecom to a large extent but other smaller companies also contribute strongly to this country's overall capability in this field.

Northern Telecom's thrust into international markets has met with considerable success in the highly competitive U.S market but markets in other industrialized countries remain virtually impenetrable because of non-tariff barriers. The extent to which these barriers can be reduced or eliminated must await the results of the current Multilateral Trade Negotiations.

With a strong market base in Canada — Northern Telecom is virtually the only supplier to the Bell system — and some of the world's leading telecommunications technology, this company's future seems assured and it plans to triple its sales by the early 1980s to more than \$3 billion annually.

A large part of the continuing growth in Northern Telecom's revenue is expected to come from foreign sales which now account for 15 per cent of the company's revenue, a share which is expected to increase to 50 per cent over the next 10 years. Even under the best of circumstances, market access and corporate citizenship requirements will necessitate that some of this production for foreign markets be carried out abroad. The size of foreign production and R&D relative to those in Canada will depend on the attractiveness of the respective business environments, some of the major factors being productivity performance relative to wage and salary increases, the costs of capital and government support of R&D. While recent developments in currency exchange rates have improved the attractiveness of the Canadian business climate, the movement of the Canadian dollar cannot be regarded as a long-term solution to our competitive problems.

The bulk of Northern Telecom's activity is currently in Canada. This includes R&D. In fact, Northern, through Bell Northern Research, has the largest industrial research establishment in Canada, currently spending more than \$75,000,000 annually and employing more than 1,400 technical and scientific staff. A relatively attractive business climate will be essential to the continued domestic development of the telecommunications sub-sector.

Other Communications

TABLE IX
Growth in Communications Equipment Output and Use
Canada 1968-1976
(\$ millions)

	1968	1976	% Change
Domestic Market	219	464	111.8
Shipments	244	467	91.4
Exports	96	201	109
Imports	71	198	179
Trade Balance	25	3	-88

Source: Disaggregation of Statistics Canada data for SIC 335 (Telecommunications)

Historically, the development of this sub-sector stems from the establishment of Canadian Marconi Company, incorporated in 1903 (as Marconi Wireless Telegraph Company of Canada) and the pioneer manufacturer of radio communication equipment in Canada.

The evolution of radar, microwave communication systems and the expansion of radio and TV broadcasting in the post-war years contributed to the manufacture in Canada of a wider range of

communication equipment during the 1950s and early 1960s. This was followed by further activity in the manufacture of communication equipment for defence and space communication systems.

Today, companies of this sub-sector produce communications equipment for sale both domestically and abroad which ranges from relatively simple mobile transceivers for vehicles, such as taxis, to more complex systems for defence applications and earth stations for satellite communication purposes. Two aspects of the performance of this sub-sector over the last nine years are worthy of note.

First, the share of the domestic market held by Canadian suppliers has declined from approximately 67 per cent in 1968 to 57 per cent in 1976, against strong competition from foreign suppliers. Over this period the growth of the domestic market has been at an average rate of 9.8 per cent per annum. Secondly, export shipments by Canadian suppliers have increased at much the same rate of 9.7 per cent per annum in response to market opportunities abroad.

This performance follows the trend in most other industrialized nations where both imports and exports have been increasing, illustrating the growth in international trade of such electronic products.

However, there is need for concern rather than complacency since the performance figures also reveal that, in Canada, imports have been increasing at a higher average rate of 13.6 per cent per annum compared to the average rate of increase of 9.7 per cent in exports.

Companies of this sub-sector have developed a strong technological ability and have demonstrated international competitiveness in specialized applications for subsystems. Technology provided by foreign parent companies and support provided by the Department of Industry, Trade and Commerce to both foreign-owned and Canadian-owned companies have contributed to this capability. However, companies of this sub-sector are very small in comparison to their international competitors and lack the corporate size and strength to develop a total systems capability and to maintain an adequate level of R&D and applications engineering. This issue is addressed in more detail in the section of this paper on Systems Electronics.

Computers and Office Equipment

TABLE X
Growth in the Use and Production of Computers and Office Equipment
Canada 1966-1976
(\$ millions)

	1968	1976	% Change
Domestic Market	283	893	215.5
Shipments	149	488	227.5
Exports	38	331	771
Imports	172	736	328
Trade Balance	-134	-405	-202

Source: Statistics Canada

Dramatic changes have taken place in this sub-sector over the last 10 to 15 years. Products have changed significantly, together with their markets. In the early 1960s, the majority of office machines were mechanical or electromechanical. Electronic computers were a relatively small proportion of the sub-sector's range of products and total sales. Over the period of the last decade or so, the importance of computers and related products has grown significantly and, in addition, most office machines have become electronic in nature.

During this period of technological change, there has been close government/industry collaboration and, as a result, the industry structure has changed considerably. Gone, in most cases, are the foreign-owned branch plants which assembled products for the Canadian market only. In some cases these plants have been phased out entirely and the domestic market is now supplied by imports. In other cases, obsolete plants have been closed down and replaced with modern facilities now producing electronic office equipment on a rationalized basis with their parent companies.

The federal government and some of the provincial governments have played a significant role in this era of change. Moral suasion, research and development grants, regional incentives and government procurement have all been used and have influenced the nature of the structure now in place.

The role of the multinational corporations has also been significant. Their influence on the manufacture and trade performance of the sub-sector has been considerable and will continue to be of importance. For example, Control Data Canada Ltd. and NCR Canada Ltd. have established manufacture of computer equipment in Canada on a rationalized basis with their parent companies. These were encouraged by substantial grants from the federal government for research and development which led to highly efficient and cost-competitive production in Canada, compared with the U.S., of a selected series of computer products.

In another case, IBM has co-operated with the federal government to implement its concept of balanced trade and has maintained levels of production and exports commensurate with its imports. It has also established a moderately sized R&D facility in Canada.

It is important to note that these adjustments took place in a period of favourable business climate. In order to ensure that these multinational firms continue to operate in Canada on this basis, and attract a wider range of corporate activity to Canada, it is important that the business climate be at least as favourable as it is in other industrialized nations.

Also during this period, a number of Canadian-owned companies started up and are striving to prosper in a highly competitive market where technology and products change rapidly. These companies, in general, produce computer peripheral equipment and the smaller, specialized data processing systems.

They have excellent technical capabilities but often experience difficulties in turning technological ideas into commercial successes. Some have found it necessary to associate themselves with larger foreign-owned firms in order to obtain adequate management and marketing skills required for sustained growth. As these companies attempt to move into export markets in competition with much larger suppliers, the need for marketing skills will be emphasized. More companies may resort to joint ventures with larger foreign-owned firms in order to obtain market share abroad.

Trends in technology and markets also suggest other changes in the future. Past efforts have been primarily directed towards increased production of hardware in Canada. Future emphasis may need a new direction because the production portion of the value added in these kinds of products is declining and the importance of R&D and software content is increasing. These trends could result in relatively fewer production employees but increased employment of engineering personnel for software and systems work.

The foregoing comments relate to the manufacture of the hardware portion of this sub-sector. There is, in addition, another important element — the computer services and software industry which has developed over the last decade. Its rapid growth is illustrated by the increase in revenues — from \$172 million in 1972 to \$400 million in 1975. Employment in this industry is in excess of 10,000 and there are approximately 400 firms whose primary business is the provision of computer services. More than 90 per cent of these firms are Canadian-owned and account for between 70-75 per cent of total revenues.

The industry got its start about 10 years ago, with a number of firms establishing in the Toronto-Ottawa-Montreal area. The federal government was an important catalyst, its large and advanced requirements for data processing services providing the initial stimulus to several of these new ventures. As in any new industry sector, characterized by rapid growth and easy entry, profitability has been weak and in many cases non-existent. This situation is beginning to change, as the smaller entrants are disappearing or are being acquired by the larger suppliers.

A concern about the industry performance a few years ago was its concentration on the central Canadian market and an unwillingness to serve the more distant, regional markets. As the larger firms have achieved a more stable operational level and more consistent profitability, this concern is disappearing. These firms are now actively pursuing markets across Canada and it is believed that the level of computer services available to Canadian users is as high as in any country in the world.

For a number of users the quality and availability of computer services is not of strategic concern since they have the valid option of purchasing and operating their own computers. For many others, however, it is. A large proportion of the market for computer services is composed of small firms, which can neither afford to purchase their own computers nor do they have the resources and capabilities to operate these machines.

The federal government has expressed considerable interest in this industry, because of its potential impact on the country in both economic and socio-cultural terms. The basic premises of

various studies and reports* issued are that the industry should remain competitive and be maintained largely under Canadian control.

The Canadian computer and office machine sub-sector has rationalized its operations to some extent over the last decade with considerable encouragement and assistance from government. The market potential for the sub-sector's products is expected to grow rapidly and, provided there is an improvement in the business climate, further rationalization by the multinational firms and development of Canadian-owned companies would lead to a stabilization of global market shares. This should be obtained without significant change in the nature of government measures.

Similarly, the computer service and software industry has promising growth potential which can be realized by government/industry co-operation in the maintenance of a predominant Canadian control and further development of indigenous technology.

Control and Instrumentation Equipment

TABLE XI
Growth in Use and Production of Control and Instrumentation Equipment
Canada 1966-1976
(\$ millions)

	1966	1976	% Change
Domestic Market	278	655	135.6
Shipments	200	439	119.5
Exports	19	59	210.5
Imports	97	275	183.5
Trade Balance	-78	-216	-176.9

Source: *Statistics Canada*.

The sector is very broad; its products and uses touch on every facet of Canadian industry from resources exploration and exploitation through to the most sophisticated manufacturing processes. Precise statistics are difficult to obtain because equipment can be exported or imported under its own categories; can be incorporated into other equipment and thus classified under another category; or the product can be broken down into individual components and classified a third way. For example, much of the navigation equipment that might be classified under this heading is listed with communications. Thus sales and exports for this sector are probably understated.

The Canadian industry is composed of a few subsidiaries of large multinational companies and a large number of much smaller indigenous Canadian companies which have carved out a specialization related to their technology or to the end market they are pursuing. Canadian subsidiaries generally assemble systems designed elsewhere, whereas indigenous companies have become highly specialized and characteristically have short production runs for custom applications.

Market life of a significant portion of the products may extend from only one to five years. The sector is therefore strongly tied to the latest advances in technology.

There is a continuing strong growth for these products with consumption in real terms doubling about every seven years. The potential for growth for this section can be attributed primarily to the use of computer techniques for automatic process control in manufacturing and the emerging demand for pollution control/monitoring equipment for all industry.

World trade has been inhibited to some extent by the non-tariff barriers of the major trading nations. Successful world traders have been the large multinational companies and specific companies which have shown clear superiority of their products in specialized market sectors. Canadian companies cannot always rely upon their domestic market to the same extent as other industrialized nations since this market has historically been open to accepting foreign suppliers, whereas the major foreign markets in the EEC, Japan and the U.S. have a strong tendency to purchase locally produced goods.

*Computer/Communications Policy, a Position Statement by the Government of Canada, 1973.

*Strategies of Development for the Canadian Computer Industry Report No. 21, Science Council of Canada September 1973.

Fifty per cent of Canadian consumption is met from Canadian sources with a high percentage of the remainder coming from the U.S. The prime reason for the large quantity of imports is the high technological content of the equipment and the domination of the computer process control market by U.S. firms.

Canadian participation in world trade is primarily through its indigenous companies and to some extent through the rationalized activities of the multinational companies which have tended to be in specialized segments of the market. Approximately 15 per cent of domestic production is exported (25 per cent, if avionics are included) with the primary market being the U.S.

Government purchasing policies (federal, provincial and municipal) can be very influential in that a large segment of the market is controlled or strongly influenced by these (e.g. the gas pipeline, hydro and transportation utilities and environmental bodies).

Horizontal integration would be beneficial. In many of the industry sub-sectors similar instrumentation and techniques may be applied to applications in sectors other than the sub-sector the company has specialized in. Several of the indigenous companies realize this but have not pursued the opportunities due to a shortage of resources. This issue is considered at greater length in the following section on systems electronics.

Systems Electronics

The term systems electronics refers to the integration of a variety of electronic equipment into a system, usually designed to monitor an activity or process and to initiate corrective and control functions if necessary. Typical applications are sophisticated industrial process control, advanced weapons control systems, air traffic control systems. By definition, systems electronics requires a mix of sensing devices, instrumentation, communications and computing.

Most Canadian electronic companies have, to date, specialized in the design and production of one or two of the subsystems (sensing, instrumentation, communication or computing) and often supply their equipment to prime contractors which provide the systems integration. The strength of companies which do systems integration (systems electronics firms) is their ability to tie together subsystems technologies, often combined with strong software capabilities, in the solution of highly complex problems (e.g. the monitoring and control of coastal shipping).

While Canada has few systems electronics firms per se, it has a number of companies which have developed an impressive subsystems ability together with an embryo systems capability. Most of them are producers of avionics equipment but there are representatives from each of the three electronics sub-sectors of communications, computer peripherals and instrumentation and control. They number about 10 companies and collectively have between \$200 and \$300 million in annual sales.

Provided they can develop a more sophisticated systems capability, the companies hold the most promise for the future growth of Canada's electronics industry. The positive features of these companies are a high degree of technological ability and international competitiveness. The major impediments to growth are: (1) the small size of most firms by international standards — most of the more important companies have less than \$50 million in sales annually; (2) foreign ownership of most key firms; and (3) lack of a full-fledged systems capability.

Generally, large-scale production facilities are unimportant for systems electronics companies since most equipment is custom-built in small orders or purchased from sub-contractors. The size of the corporate enterprise is, however, important in order to absorb the risks associated with R&D, to obtain financing for major contracts, to support applications engineering and marketing efforts which are international in scope and to have sufficient product range so that downturns in the market for one production can be offset by upturns for others.

Canada's embryonic systems electronics firms have based their success to date on intense specialization on a narrow range of products but in the longer term this specialization carries danger. One or two setbacks can seriously jeopardize the firm's viability. Moreover, markets are highly irregular as the product base narrows. Companies are often confronted with a major contract which strains their design and productive resources, followed by a sharp decline in market activity during which development and productive facilities are idle. Even a relatively short period of inactivity can have serious consequences for small firms with little to fall back on.

The history of these companies over the last decade confirms this assessment. While no major company has failed, most have shown little long-term growth. For example, between 1969 and 1973, the seven leading firms collectively had almost constant sales of \$200 million annually. Individually, however, some companies doubled sales while others suffered significant declines, primarily because

of a contraction in defence expenditures in the United States. The "development" of these companies has, therefore, essentially been devoted to contending with the stop and go nature of their markets. Rather than aiming for growth and a total systems capability, most firms have adopted a defensive posture to see them through the next downturn.

These companies have been the major recipients of government grants for R&D. The grants have taken some of the risk out of development of new products but, since they are given on a project-by-project basis and must be matched by the firm's own resources, they have done little to offset the limitations of small firm size.

Without growth, it is difficult to foresee how long the systems electronics industry can manage to survive without suffering major setbacks. As competitors grow larger and are able to devote more resources to product development and marketing, survival on the old basis of defending against downturns must become more difficult. The companies with the best chance of survival may, in fact, be the subsidiaries of multinational firms able to rely on resources of their parent to carry them through periods of inactivity. Canadian-owned firms will not have this option.

In these circumstances, it is apparent that steps will have to be taken to give firms in the systems electronics industry a better basis for growth through the development of a full-fledged systems capability.

CONCLUSIONS

In present circumstances, the outlook for Canada's electronics industry is not encouraging. At least one major sector faces a significant decline in activity which will be impossible to reverse. All sectors will be greatly influenced by the business climate in Canada. Electronics is a footloose industry and, with a small domestic market and relatively free trade, there is no necessary reason that electronics products should be made in Canada. Unlike the situation in certain resource industries where the mere possession of the resource provides some assurance of future activity, electronics is free to gravitate to where the business environment is most satisfactory.

The governments of most industrialized countries have identified the electronics industry as a key industrial sector. They are prepared to offer considerable inducements to the industry, including R&D support, special tax treatment, equity participation, procurement and protection. To offset this, it is, therefore, essential that Canada be a competitive place to locate and conduct business.

While Canada's record in the production of electronics has shown some bright spots, there are a sufficient number of problems confronting the industry that a complacent attitude could lead to a gradual diminution of the industry's importance. Canada possesses no particular advantages, such as a large market, to prevent this becoming a reality.

On the other hand, there are some very real centres of strength in the Canadian electronics industry, primarily in telecommunications and systems electronics but also including the rationalized activities of multinational firms. The key to the future is the business climate, augmented by other initiatives such as consolidation of the industry structure and further development of its strengths on a selective and specialized basis.

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